SYSTEM AND METHOD FOR CONTROLLING A MOTORIZED WINDOW COVERING

1. Related Applications

The present invention is a Continuation-in-Part of U.S. Patent Application serial number 10/062,921 filed on February 1, 2002.

2. Field Of The Invention

The present invention relates generally to window covering peripherals and more particularly to remotely-controlled window covering actuators.

3. Background Of The Invention

Window coverings that can be opened and closed are used in a vast number of business buildings and dwellings. Examples of such coverings include horizontal blinds, vertical blinds, pleated shades, roll-up shades, and cellular shades made by, e.g., Spring Industries, Hunter-Douglas, and Levellor.

The present assignee has provided several systems for either lowering or raising a window covering, or for moving the slats of a window covering between open and closed positions. Such systems are disclosed in U.S. Patent Numbers 6,189,592, 5,495,153, and 5,907,227, incorporated herein by reference. These systems include a motor driven gear box that is coupled to a tilt rod of the window covering. When the motor is energized, the tilt rod rotates clockwise or counterclockwise. These systems can, e.g., include actuators that are mechanically coupled to the window coverings and operated via a remote control unit. As recognized herein, with a relatively wide remote control signal, if two or more actuators are placed in close proximity to each other, e.g., in the situation where two or more windows are side by side and each includes a remote signal receiver, it can be very difficult to control a single actuator with the remote control unit. In other

words, a user may be unable to direct the signal beam at just one receiver.

As a result, the present invention recognizes a need for a system that will allow control of a single motorized window covering within an array of motorized window coverings.

SUMMARY OF THE INVENTION

A system for controlling a motorized window covering includes an actuator that is mechanically coupled to an operator of the window covering. A remote control unit selectively communicates with the actuator. A visible light beam emitter and an encoded light beam emitter are installed within the remote control unit. The visible light beam emits a blinking visible light beam.

In a preferred embodiment, the encoded light beam emitter emits an encoded light beam that is superimposed on the blinking visible light beam. Preferably, the blinking visible light beam is similar in size and shape to the encoded light beam. Also, the encoded light beam is coaxial, or approximately coaxial, with the blinking visible light beam. In a preferred embodiment, the blinking visible light beam blinks at a rate of approximately between two and four pulses per second, inclusive. Moreover, each pulse of the visible light beam has a duty cycle of between approximately twenty percent and fifty percent, inclusive.

In another aspect of the present invention, a remote control unit for controlling a motorized window covering includes a visible light beam emitter and an encoded light beam emitter housed with the visible light beam emitter. In this aspect, the visible light beam emitter emits a blinking visible light beam that aids a user in directing the light from the encoded emitter.

In yet another aspect of the present invention, a method for controlling a motorized window covering with a remote control unit includes providing a blinking visible light beam and an encoded light beam superimposed over the blinking visible light beam. The encoded light beam carries control data. In this aspect, the blinking visible light beam is used to direct the encoded light beam.

In still another aspect of the present invention, a remote control unit for controlling a motorized window covering includes means for emitting a blinking visible light beam and means for emitting an encoded light beam.

The details of the present invention, both as to its construction and operation, can best be understood in reference to the accompanying drawings, in which like numerals refer to like parts, and which:

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a window covering actuator of the present invention, shown in one intended environment, with portions of the head rail cut away for clarity;

Figure 2 is a perspective view of the gear assembly of the actuator of the present invention, with portions broken away;

Figure 3A is a perspective view of the main reduction gear of the actuator of the present invention;

Figure 3B is a cross-sectional view of the main reduction gear of the actuator of the present invention, as seen along the line 3B-3B in Figure 3A;

Figure 4 is a side plan view of a remote control unit emitting a control signal beam directed at an array of actuators; and

Figure 5 is a cross-section view of the control signal beam.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring initially to Figure 1, an actuator is shown, generally designated 10. As shown, the actuator 10 is in operable engagement with a rotatable tilt rod 12 of a window covering, such as but not limited to a horizontal blind 14 having a plurality of louvered slats 16. As shown, the tilt rod 12 is rotatably mounted by means of a block 18 in a head rail 20 of the blind 14.

In the embodiment shown, the blind 14 is mounted on a window frame 22 to cover

a window 24, and the tilt rod 12 is rotatable about its longitudinal axis. The tilt rod 12 engages a baton (not shown), and when the tilt rod 12 is rotated about its longitudinal axis, the baton (not shown) rotates about its longitudinal axis and each of the slats 16 is caused to rotate about its respective longitudinal axis to move the blind 14 between an open configuration, wherein a light passageway is established between each pair of adjacent slats, and a closed configuration, wherein no light passageways are established between adjacent slats.

While the embodiment described above discusses a horizontal blind, it is to be understood that the principles of the present invention apply to a wide range of window coverings including, but not limited to the following: vertical blinds, fold-up pleated shades, roll-up shades, cellular shades, skylight covers, and any type of blinds that utilize vertical or horizontal louvered slats.

A control signal generator, preferably a daylight sensor 28 is mounted within the actuator 10 by means well-known in the art, e.g., solvent bonding. In accordance with the present invention, the daylight sensor 28 is in light communication with a light hole 30 through the back of the head rail 20, shown in phantom in Figure 1. Also, the sensor 28 is electrically connected to electronic components within the actuator 10 to send a control signal to the components, as more fully disclosed below. Consequently, with the arrangement shown, the daylight sensor 28 can detect light that propagates through the window 24, independent of whether the blind 14 is in the open configuration or the closed configuration.

Further, the actuator 10 can include another control signal generator, preferably a signal sensor 32, for receiving a preferably optical user command signal. Preferably, the user command signal is generated by a hand-held user command signal generator 34, which can be an infrared (IR) remote-control unit. In one presently preferred embodiment, the generator 34 generates a pulsed signal.

Like the daylight sensor 28, the signal sensor 32 is electrically connected to electronic components within the actuator 10. As discussed in greater detail below, either

one of the daylight sensor 28 and signal sensor 32 can generate an electrical control signal to activate the actuator 10 and thereby cause the blind 14 to move toward the open or closed configuration, as appropriate.

Preferably, both the daylight sensor 28 and signal sensor 32 are light detectors which have low dark currents, to conserve power when the actuator 10 is deactivated. More particularly, the sensors 28, 32 have dark currents equal to or less than about 10^{-8} amperes and preferably equal to or less than about $2x10^{-9}$ amperes.

As shown in Figure 1, a power supply 36 is mounted within the head rail 20. In the preferred embodiment, the power supply 36 includes four or six or other number of type AA direct current (dc) alkaline or Lithium batteries 38, 40, 42, 44. Or, the batteries can be nine volt transistor batteries. The batteries 38, 40, 42, 44 are mounted in the head rail 20 in electrical series with each other by means well-known in the art. For example, in the embodiment shown, two pairs of the batteries 38, 40, 42, 44 are positioned between respective positive and negative metal clips 46 to hold the batteries 38, 40, 42, 44 within the head rail 20 and to establish an electrical path between the batteries 38, 40, 42, 44 and their respective clips.

Figure 1 further shows that an electronic circuit board 48 is positioned in the head rail 20 beneath the batteries 38, 40, 42, 44. It can be appreciated that the circuit board 48 can be fastened to the head rail 20, e.g., by screws (not shown) or other well-known method and the batteries can be mounted on the circuit board 48. It is to be understood that an electrical path is established between the battery clips 46 and the electronic circuit board 48. Consequently, the batteries 38, 40, 42, 44 are electrically connected to the electronic circuit board 48. Further, it is to be appreciated that the electronic circuit board 48 may include a microprocessor.

Still referring to Figure 1, a lightweight metal or molded plastic gear box 50 is mounted preferably on the circuit board 48. The gear box 50 can be formed with a channel 51 sized and shaped for receiving the tilt rod 12 therein. As can be appreciated in reference to Figure 1, the tilt rod 12 has a hexagonally-shaped transverse cross-section,

and the tilt rod 12 is slidably engageable with the gear box opening 51. Accordingly, the actuator 10 can be slidably engaged with the tilt rod 12 substantially anywhere along the length of the tilt rod 12.

Figure 1 also shows that a small, lightweight electric motor 52 is attached to the gear box 50, preferably by bolting the motor 52 to the gear box 50. As more fully disclosed in reference to Figure 2 below, the gear box 50 holds a gear assembly which causes the tilt rod 12 to rotate at a fraction of the angular velocity of the motor 52. Preferably, the motor 52 can be energized by the power supply 36 through the electronic circuitry of the circuit board 48 and can be mounted on the circuit board 48.

Also, in a non-limiting embodiment, a manually manipulable operating switch 54 can be electrically connected to the circuit board 48. The switch 54 shown in Figure 1 is a two-position on/off power switch used to turn the power supply on and off. Further, a three-position mode switch 56 is electrically connected to the circuit board 48. The switch 56 has an "off" position, wherein the daylight sensor 28 is not enabled, a "day open" position, wherein the blind 14 will be opened by the actuator 10 in response to daylight impinging on the sensor 28, and a "day shut" position, wherein the blind 14 will be shut by the actuator 10 in response to daylight impinging on the sensor 28.

Figure 1 further shows that in another non-limiting embodiment, a manually manipulable adjuster 58 can be rotatably mounted on the circuit board 48 by means of a bracket 60. The periphery of the adjuster 58 extends beyond the head rail 20, so that a person can turn the adjuster 58.

As intended by the present invention, the adjuster 58 can have a metal strip 62 attached thereto, and the strip 62 on the adjuster 58 can contact a metal tongue 64 which is mounted on the tilt rod 12 when the tilt rod 12 has rotated in the open direction.

When the strip 62 contacts the tongue 64, electrical contact is made therebetween to signal an electrical circuit on the circuit board 48 to de-energize the motor 52. Accordingly, the adjuster 58 can be rotationally positioned as appropriate such that the strip 62 contacts the tongue 64 at a predetermined angular position of the tilt rod 12.

Stated differently, the tilt rod 12 has a closed position, wherein the blind 14 is fully closed, and an open position, wherein the blind 14 is open, and the open position is selectively established by manipulating the adjuster 58.

Now referring to Figures 2, 3A, and 3B, the details of the gear box 50 can be seen. As shown best in Figure 2, the gear box 50 includes a plurality of lightweight metal or molded plastic gears, i.e., a gear assembly, and each gear can be rotatably mounted within the gear box 50. In the presently preferred embodiment, the gear box 50 is a clamshell structure which includes a first half 65 and a second half 66, and the halves 65, 66 of the gear box 50 are snappingly engageable together by means well-known in the art. For example, in the embodiment shown, a post 67 in the second half 66 of the gear box 50 engages a hole 68 in the first half 65 of the gear box 50 in an interference fit to hold the halves 65, 66 together.

Each half 62, 64 includes a respective opening 70, 72, and the openings 70, 72 of the gear box 50 are coaxial with the gear box channel 51 (Fig. 1) for slidably receiving the tilt rod 12 therethrough.

As shown in Figure 2, a motor gear 74 is connected to the rotor 76 of the motor 60. In turn, the motor gear 74 is engaged with a first reduction gear 78, and the first reduction gear 78 is engaged with a second reduction gear 80. In turn, the second reduction gear 80 is engaged with a main reduction gear 82. To closely receive the hexagonally-shaped tilt rod 12, the main reduction gear 82 has a hexagonally-shaped channel 84. As intended by the present invention, the channel 84 of the main reduction gear 82 is coaxial with the openings 70, 72 (and, thus, with the gear box channel 51 shown in Figure 1).

It can be appreciated in reference to Figure 2 that when the main reduction gear 82 is rotated, and the tilt rod 12 is engaged with the channel 84 of the main reduction gear 82, the sides of the channel 84 contact the tilt rod 12 to prevent rotational relative motion between the tilt rod 12 and the main reduction gear 82. Further, the reduction gears 78, 80, 82 cause the tilt rod 12 to rotate at a fraction of the angular velocity of the motor 60.

Preferably, the reduction gears 78, 80, 82 reduce the angular velocity of the motor 60 such that the tilt rod 12 rotates at about one revolution per second. It can be appreciated that greater or fewer gears than shown can be used.

It is to be understood that the channel 84 of the main reduction gear 82 can have other shapes suitable for conforming to the shape of the particular tilt rod being used. For example, for a tilt rod (not shown) having a circular transverse cross-sectional shapes, the channel 84 will have a circular cross-section. In such an embodiment, a set screw (not shown) is threadably engaged with the main reduction gear 82 for extending into the channel 84 to abut the tilt rod and hold the tilt rod stationary within the channel 84. In other words, the gears 74, 78, 80, 82 described above establish a coupling which operably engages the motor 60 with the tilt rod 12.

In continued cross-reference to Figures 2, 3A, and 3B, the main reduction gear 82 is formed on a hollow shaft 86, and the shaft 86 is closely received within the opening 70 of the first half 62 of the gear box 50 for rotatable motion therein. Also, in a non-limiting embodiment, a first travel limit reduction gear 88 is formed on the shaft 86 of the main reduction gear 82. The first travel limit reduction gear 88 is engaged with a second travel limit reduction gear 90, and the second travel limit reduction gear 90 is in turn engaged with a third travel limit reduction gear 92.

Figure 2 best shows that the third travel limit reduction gear 92 is engaged with a linear rack gear 94. Thus, the main reduction gear 82 is coupled to the rack gear 94 through the travel limit reduction gears 88, 90, 92, and the rotational speed (i.e., angular velocity) of the main reduction gear 82 is reduced through the first, second, and third travel limit reduction gears 88, 90, 92. Also, the rotational motion of the main reduction gear 82 is translated into linear motion by the operation of the third travel limit reduction gear 92 and rack gear 94.

Figure 2 also shows that in non-limiting embodiments, the second reduction gear 80 and second and third travel limit reduction gears 90, 92 can be rotatably engaged with respective metal post axles 80a, 90a, 92a which are anchored in the first half 65 of the

gear box 50. In contrast, the first reduction gear 78 is rotatably engaged with a metal post axle 78a which is anchored in the second half 66 of the gear box 50.

Still referring to Figure 2, the rack gear 94 can be slidably engaged with a groove 96 that is formed in the first half 65 of the gear box 50. First and second travel limiters 98, 100 can be connected to the rack gear 94. In the non-limiting embodiment shown, the travel limiters 98, 100 are threaded, and are threadably engaged with the rack gear 94. Alternatively, travel limiters (not shown) having smooth surfaces may be slidably engaged with the rack gear 94 in an interference fit therewith, and may be manually moved relative to the rack gear 94.

As yet another alternative, travel limiters (not shown) may be provided which are formed with respective detents (not shown). In such an embodiment, the rack gear is formed with a channel having a series of openings for receiving the detents, and the travel limiters can be manipulated to engage their detents with a preselected pair of the openings in the rack gear channel. In any case, it will be appreciated that the position of the travel limiters of the present invention relative to the rack gear 94 may be manually adjusted.

Figure 2 shows that in one non-limiting embodiment, each travel limiter 98, 100 has a respective abutment surface 102, 104. As shown, the abutment surfaces 102, 104 can contact a switch 106 which is mounted on a base 107. The base 107 is in turn anchored on the second half 66 of the gear box 50. As intended by the present invention, the switch 106 includes electrically conductive first and second spring arms 108, 112 and an electrically conductive center arm 110. As shown, one end of each spring arm 108, 112 is attached to the base 107, and the opposite ends of the spring arms 108, 112 can move relative to the base 107. As also shown, one end of the center arm 110 is attached to the base 107.

When the main reduction gear 82 has rotated sufficiently counterclockwise, the abutment surface 102 of the first travel limiter 98 contacts the first spring arm 108 of the switch 106 to urge the first spring arm 108 against the stationary center arm 110 of the switch 106. On the other hand, when the main reduction gear 82 has rotated clockwise a

sufficient amount, the abutment surface 104 of the second travel limiter 100 contacts the second spring arm 112 of the switch 106 to urge the second spring arm 112 against the stationary center arm 110 of the switch 106.

It can be appreciated in reference to Figure 2 that the switch 106 can be electrically connected to the circuit board 52 (Figure 1) via an electrical lead 119. Moreover, the first spring arm 108 can be urged against the center arm 110 to complete one branch of the electrical circuit on the circuit board 48. On the other hand, the second spring arm 112 can be urged against the center arm 110 to complete another branch of the electrical circuit on the circuit board 48.

The completion of either one of the electrical circuits discussed above causes the motor 52 to de-energize and consequently stops the rotation of the main reduction gear 82 and, hence, the rotation the tilt rod 12. Stated differently, the travel limiters 98, 100 may be manually adjusted relative to the rack gear 94 as appropriate for limiting the rotation of the tilt rod 12 by the actuator 10.

Referring briefly back to Figure 2, spacers 120, 122 may be molded onto the halves 62, 64 for structural stability when the halves 62, 64 of the gear box 56 are snapped together.

Referring now to Figure 4, details of the remote control unit 34 are shown. Figure 4 shows that the remote control unit 34 includes a visible light beam emitter 200 and an invisible, e.g., IR, encoded light beam emitter 202. It is to be understood that in lieu of an invisible light beam emitter 202 an RF transmitter or other means of communication can be used. As shown, the visible light beam emitter 200 emits a relatively narrow visible light beam 204 that is visible when it strikes an object. Moreover, the encoded light beam emitter 202 emits an encoded light beam 206 that preferably is substantially the same size and shape as the visible light beam 204. It is to be understood that the encoded light beam 206 carries the actuator control data.

In a preferred embodiment, the encoded light beam 206 is superimposed on the visible light beam 204 such that the light beams 204, 206 are more or less coaxial. A low

power laser or a focused high intensity light emitting diode (LED) in the visible light range are preferred for use as the visible light beam emitter 202. In a less preferred embodiment, an incandescent bulb can be used.

According to present principles, if the visible light beam emitter 202 is a visible LED or an incandescent bulb, the intensity of the visible light beam 204 can be limited by the visible light beam emitter 202 or the power available thereto. In either case, the visible light beam 204 can be difficult to observe at distances consistent with the range of the encoded light beam 206 especially in areas of high ambient light. To overcome this limitation, the visible light beam 204 preferably is blinked at a rate fast enough to allow the operator to continuously know the location of the encoded light beam 206. It can be appreciated that the duration of the ON time must be longer than retinal response to assure that the blinking visible light beam 204 is not integrated by the eye. In a preferred embodiment, the blinking visible light beam 204 blinks at a rate approximately between two and four pulses per second, inclusive. Also, in a preferred embodiment, the duration of the ON time is at a duty cycle of between approximately twenty percent and fifty percent, inclusive. If desired, each pulse may last no more than approximately eighty three and three-tenths milliseconds (83.3 ms), providing a duty cycle of approximately twenty five percent (25%). This duty cycle allows the instantaneous output power of the visible light beam emitter 202 to be increased fourfold, which effectively doubles the range of the visible light beam 204 for any given conditions of the ambient light.

It is to be understood that for shorter operating distances or for operation in low levels of ambient light, the function of pointing and controlling can be combined, e.g., in the light beam of a single emitter. It can be appreciated that for distances greater than fifty feet, a higher powered laser can be used for the visible light beam emitter 202. However, it can be appreciated that if the visible light beam 204 is produced by a laser, it is important to minimize its power for both regulatory and safety concerns. If the visible light beam is a laser, the encoded light beam may be broader than the visible light beam, but should be as narrow as practicable for optimum selectivity.

Figure 4 shows that the light beams 204, 206 can be directed at an array of actuators 208. The array of actuators 208 include a first actuator 210, a second actuator 212, and a third actuator 214. Each actuator 210, 212, 214 is identical to the actuator 10 described above. It can be appreciated that more or less than three actuators can be used.

Referring to Figure 5, it is shown that the first actuator 210 includes a first signal sensor 216 and the second actuator 212 includes a second signal sensor 218. Figure 5 shows the light beams 204, 206 striking the first actuator 210. As shown, the visible light beam 204 aids a user in pointing the remote control 34 so that the encoded light beam 206 is precisely directed at one of the signal sensors 216, 218, e.g., the first signal sensor 216 as shown. Thus, a user is able to individually control the actuators 210, 212, 214. It is to be understood that the configuration described above, e.g., the visible/invisible signal configuration, can be used in any remote-control unit where ambiguity might arise at the receiver.

While the particular SYSTEM AND METHOD FOR CONTROLLING A MOTORIZED WINDOW COVERING as herein shown and described in detail is fully capable of attaining the above-described aspects of the invention, it is to be understood that it is the presently preferred embodiment of the present invention and thus, is representative of the subject matter which is broadly contemplated by the present invention, that the scope of the present invention fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the present invention is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural and functional equivalents to the elements of the above-described preferred embodiment that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the present invention, for it is to be encompassed by the present claims. Furthermore,

no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. section 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

WE CLAIM: